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(56) Documents Cited

GB 2166119 A

GB 2062493 A

US 5306469 A

US 3840207 A

(58) Field of Search

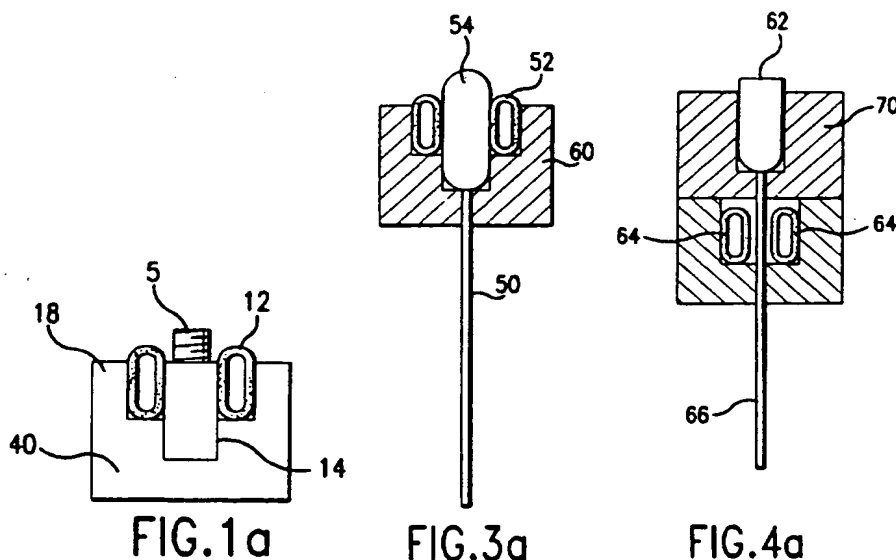
UK CL (Edition N ) B1X, F2V VP101 VS11

INT CL<sup>6</sup> B01L 9/00 9/06, F16K 7/07

Online: WPI

(54) Gripping apparatus based on loop of pressure-modified tubing

(57) An improved gripping and pinching device particularly useful with laboratory glassware and adaptable for use with a robot or automated system, is disclosed. The device uses a loop of flexible tubing (12, 52 and 64) as a gripper, eyedropper pincher and as a pinch valve (see figures 1a, 3a and 4a respectively). This is achieved by connecting the loop of flexible tubing to vacuum or pressurizing means in order to bias and unbias the walls of the tubing.



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

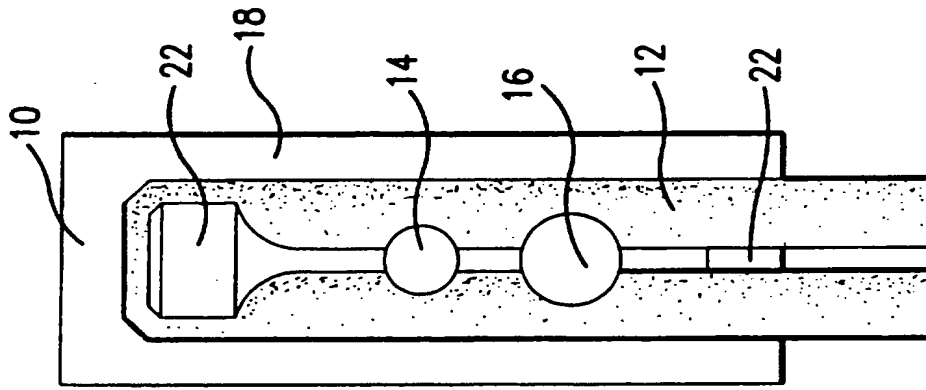


FIG. 2

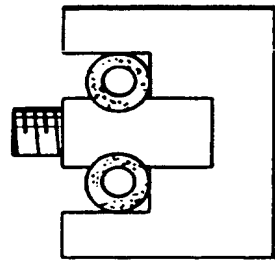


FIG. 1b

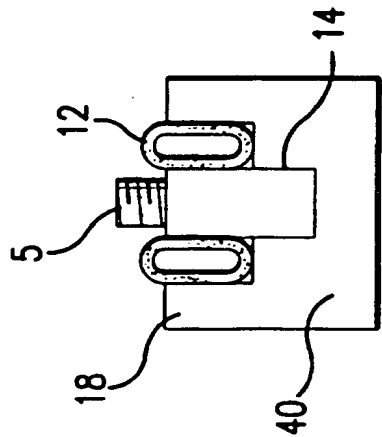


FIG. 1a

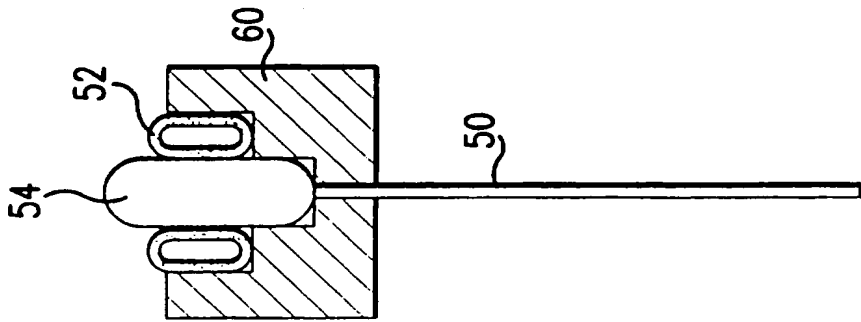


FIG. 3a

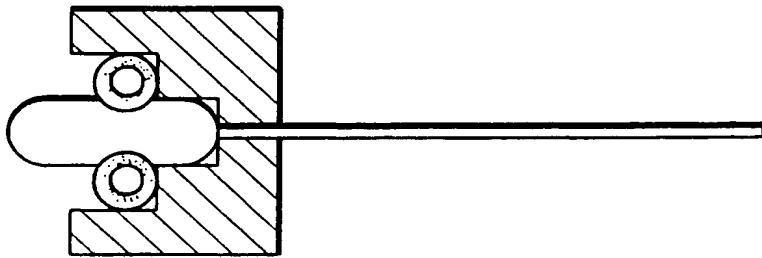


FIG. 3b

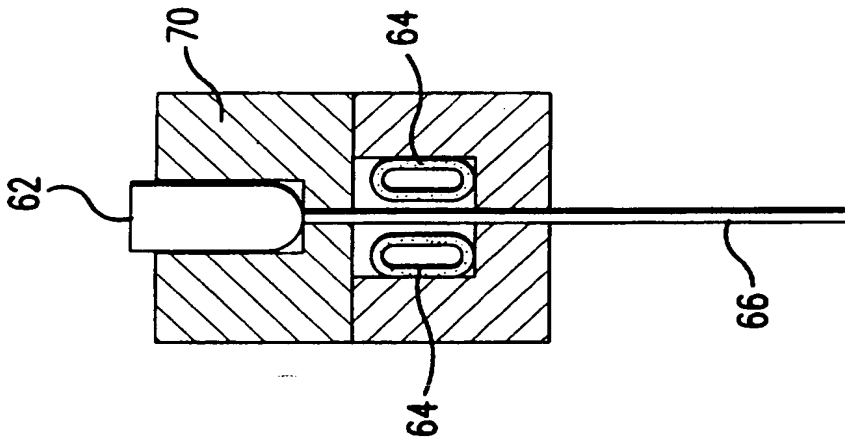


FIG. 4a

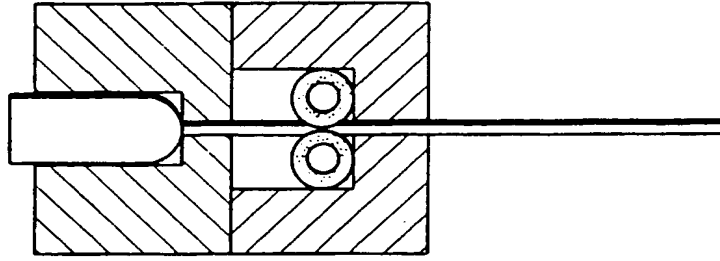


FIG. 4b

TITLE OF THE INVENTION  
GRIPPING APPARATUS

BACKGROUND OF THE INVENTION

5           This invention relates to a novel gripping apparatus of the type used, for example, on remote manipulators and robotic devices. The gripper involves a simple but highly efficient way to grasp test tubes, vials and other lab vessels while a robot or automated system performs other operations on said test tube, vial or other lab ware.  
10       Additionally, the apparatus can be used as a pincher for working an eyedropper bulb or as a pinch valve to control the flow of liquids.

          In recent years, a considerable amount of work has gone into laboratory robots. Systems have been developed for robotic methods for carrying out automatic pipetting, filtering, dilutions,  
15       spectrometry, titrations of various sorts, and other automatic procedures involving organic syntheses, testing and sample preparations. Much of the robot-automated work is preparative in nature and relates to use in analytical systems for a wide variety of applications such as analyses of polymers, food samples, extraction of  
20       drugs from biological fluids, etc.

          As the work in laboratory robotics advanced, various devices have been developed which put increased demand on the equipment normally associated with robotic manipulation. US Patent No. 4,607,196, for example, discloses a bottle capper which requires  
25       that a gripper of lab containers hold the container sufficiently tight to allow the unscrewing of container caps. US Patent No. 4,740,025 discloses a compound gripper device that assures release of a smooth article from a high-friction gripping surface which often tends to adhere to the article being gripped. This device is allegedly useful for  
30       different types of containers.

          However, none of the previous devices combine the high-friction gripping of the present invention with a simple, elegant, low-cost mechanism.

### SUMMARY OF THE INVENTION

This invention relates to a novel gripping apparatus for gripping test tubes, vials and the like which comprises a housing element containing a plurality of chambers for holding said test tubes, vials or the like and recessed beneath said housing, an area containing  
5 flexible tubing able to bias said test tubes, vials or the like upon removal of vacuum or other pressurizing means and able to release said test tubes, vials or the like upon application of said vacuum or other pressurizing means.

This invention also relates to a novel pinching apparatus  
10 which may be used with a number of eyedroppers or the like where aspirating and dispensing are necessary. Additionally, this invention relates to a novel type of pinch valve for use in a laboratory environment.

It is contemplated that the invention may be used in its  
15 embodiment as a tube gripper when temperature control of the tubes, vials or the like is necessary. Heated or cooled water can circulate through the flexible tubing while the vessel is being held. When the vacuum means is applied, the water is displaced and the vessel is released. Additionally, it is contemplated that this invention would  
20 be useful in the handling of radioactive or other types of hazardous materials because of its simple, but effective design and easy disposal in the event of contamination.

Other uses of the invention will be obvious to those  
25 skilled in the art upon consideration of this disclosure.

### BRIEF DESCRIPTION OF THE DRAWINGS

This invention is illustrated in the drawings wherein:

- 30 FIG. 1a illustrates the invention with the flexible tubing unbiased in the tube gripping aspect of the invention.
- FIG. 1b illustrates the invention with the flexible tubing biased in the tube gripping aspect of the invention.

FIG. 2 is a top view of the housing with two holes for different size vessels with the tubing biased.

5 FIG. 3a illustrates the use as an eyedropper pincher with the flexible tubing biased.

FIG. 3b illustrates the use as an eyedropper pincher with the flexible tubing unbiased.

10 FIG. 4a illustrates the use as a pinch valve with the vacuum means present.

15 FIG. 4b illustrates the use as a pinch valve with the vacuum means removed.

### DETAILED DESCRIPTION OF THE INVENTION

Referring more particularly to the drawings, wherein like numbers designate like parts throughout, the number 10 designates generally the housing portion of the gripping embodiment of the invention.

20 Referring to FIG. 1, the housing 10 includes two longitudinal edges 18 attached to the bottom side of the housing surface 40. Also attached to the bottom side of the housing surface 40 at each end thereof are tabs 22 for placing the flexible tubing 12. On the top of the housing surface 40, spaced suitably to permit the manipulation of the vessels, are chambers 14 and 16 for holding said vessels.

25 The housing 10 may be made out of any suitable material in particular HDPE, aluminum or Delrin® and the housing surface may be of such a size as to permit a plurality of different sized tubes to be gripped by the flexible tubing. The housing is preferably a single piece of machined plastic with the longitudinal walls and tabs formed in the machining process. This is preferred to avoid the use of

any adhesive or other suitable attaching means which would not be as strong as a single machined piece. Optionally, the longitudinal edges 18 can be angled such that the tubing 12 is better able to bias different sized vessels which are placed in the housing. However, the tubes must be within the position of the flexible tubing and the location of  
5 the vessel in chambers 14 and 16 in such a way that when the flexible tubing is pressurized or vented to the atmosphere, the tubing's elasticity will cause the tubing to partially wrap around the vessel, firmly gripping it. When the flexible tubing is evacuated, the tubing will collapse, releasing contact with the vessel.

10 The flexible tubing 12 can be made out of silicon rubber or any type of rubber that is resilient and retains elasticity upon repeat pressurization.

The tubing is arranged such that the two open ends are connected to the vacuum means and the looped end is around one of  
15 the tabs 22 in such a manner as to prevent slippage of the tubing.

The particular vacuum or pressure means used to bias and unbias the flexible tubing are not shown because these devices are generally known in the art.

20 The particular means to control the vacuum or other pressure means is not shown because it forms no part of the invention and many such means are known in the art.

Referring to FIG. 3a, the eyedropper 50 is positioned in a housing 60 of any type which is adaptable to a robot or automated  
25 system. Flexible tubing 52 is positioned in such a way so it is able to contact the eyedropper squeeze bulb 54 when the vacuum is removed. Upon application of the vacuum, the flexible tubing flattens and the eyedropper's bulb expands to suction the fluid.

30 In a third embodiment of the invention, referring to FIGS. 4a and 4b, a pneumatic pinch valve is shown. Vessel 62 is held in a housing 70 of the type which is adaptable to a robot or automated system. Flexible tubing 64 is positioned on each side of a flexible exit tube 66. When a vacuum is applied, the flexible tubing 64 collapses

releasing the flexible exit tube 66. When a vacuum is removed the flexible tubing 64 squeezes against the flexible exit tube 66 and flattens it resulting in a pinching effect which stops the release of fluid from the exit tube.

5 Obviously many modifications and variations of the present invention are possible in light of the foregoing teaching. It is to be understood, therefore, that within the scope of the appended claims, the present invention may be practiced otherwise than as is specifically disclosed herein.

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**WHAT IS CLAIMED IS:**

1. A tool for gripping and releasing test tubes, vials or the like which comprises:

- 5                   a) a housing element adaptable to a robot or automated system containing a plurality of chambers for holding said tubes, vials or the like;
- 10                  b) recessed beneath said housing element an area containing a loop of flexible tubing able to bias said test tubes, vials or the like;
- 15                  c) said flexible tubing connected to vacuum or other pressurizing means in order to effectuate the biasing and unbiasing of the flexible tubing with respect to said tubes, vials or the like.

2. A tool for pinching and releasing the bulb of an eyedropper which comprises:

- 20                   a) a housing to hold the eyedropper; and
- 25                   b) said eyedropper situated in said housing such that the bulb is located between a loop of flexible tubing supported by said housing, such that the tubing may bias the eyedropper bulb when the ends of the tubing are open to the atmosphere, and
- 30                   c) such that the tubing unbias the eyedropper bulb upon application of vacuum or other pressure means.

3. A pinch valve tool for pinching and releasing a flexible exit tube which comprises:

- a) a housing for holding a vessel;
- b) said vessel having a flexible exit tube;
- c) said vessel mounted on said housing; said housing containing an opening around said exit tube wherein a loop of flexible tubing is situated such that when the ends of the tubing are open to the atmosphere said tubing biases said exit tube resulting in the flattening of said tube and totally restricting the exit of any fluid via the exit tube; and
- d) when the ends of the bulb are pressurized using a vacuum or other pressure means, said tubing unbiases said exit tube resulting in the exit of fluid via the exit tube.

4. The tool as claimed in Claim 1 wherein the flexible tubing is optionally able to be filled with water in order to control the temperature of the material within the vessel being gripped.

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**Patents Act 1977**  
**Examiner's report to the Comptroller under Section 17**  
**(The Search report)**

Application number  
 GB 9515179.1

**Relevant Technical Fields**

- (i) UK Cl (Ed.N)      B1X; F2V (VP101, VS11)  
 (ii) Int Cl (Ed.6)      B01L 9/00, 9/06; F16K 7/07

Search Examiner  
 MR S QUICK

Date of completion of Search  
 27 SEPTEMBER 1995

**Databases (see below)**

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE: WPI

Documents considered relevant  
 following a search in respect of  
 Claims :-  
 1-4

**Categories of documents**

- |  |   |
|--|---|
| <p><b>X:</b> Document indicating lack of novelty or of inventive step.</p> <p><b>Y:</b> Document indicating lack of inventive step if combined with one or more other documents of the same category.</p> <p><b>A:</b> Document indicating technological background and/or state of the art.</p> | <p><b>P:</b> Document published on or after the declared priority date but before the filing date of the present application.</p> <p><b>E:</b> Patent document published on or after, but with priority date earlier than, the filing date of the present application.</p> <p><b>&amp;:</b> Member of the same patent family; corresponding document.</p> |
|--|---|

Category	Identity of document and relevant passages		Relevant to claim(s)
A	GB 2166119 A	(ROTAPRINT) see abstract and tubes 10 and 11	1
A	GB 2062493 A	(SECRETARY OF STATE FOR SOCIAL SERVICES) see abstract	2
A	US 5306469 A	(ABBOTT LABORATORIES) see Figure 9 (element 82)	1
A	US 3840207 A	(C W CARPENTER) see Figures 1 and 2 (tubing 10)	3

**Databases:** The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).